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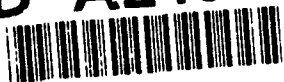|||||||||||||||||||||||||

Savings in relearning face-name associations as evidence for "covert recognition" in prosopagnosia

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13. ABSTRACT (Maximum 200 words) Prosopagnosic patients appear to be impaired at recognizing faces. However, recent evidence for "covert recognition" in prosopagnosia has been taken to suggest that the impairment is *not* in face recognition per se, but rather in conscious access to face recognition. The most widely used test for covert recognition of faces in prosopagnosia is the face-name relearning task, in which some prosopagnosics have been found to learn correct names for previously familiar faces more easily than incorrect names. Although this phenomenon is consistent with face recognition operating normally but out of reach of conscious awareness, it may also be consistent with an impairment in face recognition per se. Perhaps savings in relearning is sufficiently sensitive to the residual information contained in degraded face representations that are not detectable by overt measures of recognition. If so, then we should expect to observe this same savings in relearning when overt recognition is obliterated for reasons other than brain damage. In the present study, we used forgetting of face-name associations in normal subjects as a way of degrading recognition ability. We found the same dissociation between overt recognition performance and savings in relearning as observed in prosopagnosic patients. This implies that the performance of prosopagnosic patients in these tasks does not demand explanation in terms other than an impairment in face recognition per se.

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Abstract

Prosopagnosic patients appear to be impaired at recognizing faces.
However, recent evidence for "covert recognition" in prosopagnosia has
been taken to suggest that the impairment is _not_ in face recognition per
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relearning as observed in prosopagnosic patients. This implies that the
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explanation in terms other than an impairment in face recognition per
se.

Dissociations between perception and awareness of perception can occur in several different neuropsychological syndromes. For example, in blindsight (e.g., Weiskrantz, 1986), cortically blind patients can discriminate the position and other visual properties of stimuli for which they report no conscious percept. In neglect, there have been reports of patients showing consistent preferences when asked to choose between two stimuli, even though they were unable to consciously detect any difference between the stimuli (Marshall & Halligan, 1988). Some pure alexic patients can make accurate lexical decisions and semantic judgements about words that they claim not to recognize (e.g., Shallice & Saffran, 1986).

Similarly, in prosopagnosia, there have been several reports of "covert recognition" of faces (see Bruyer, 1991, for a review). Patients who are grossly impaired at "overt" tests of recognition, such as naming a face, or discriminating familiar from unfamiliar faces, may nevertheless manifest knowledge of facial identity in a variety of different tasks. For example, prosopagnosics have been reported to be faster at matching pictures of familiar than unfamiliar faces, even though they cannot overtly categorize the pictures as familiar or unfamiliar (De Haan, Young & Newcombe, 1987). In categorizing printed names as instances of actors or politicians, prosopagnosics may be faster when a face from the same professional category is shown with the name than when a face from a different category is shown (De Haan, et al., 1987). In the most widely used test of covert recognition, some prosopagnosics learn to associate previously familiar faces with their correct names more easily than with incorrect names (Bruyer, Laterre, Seron, Feyereisen, Strypstein, Pierrard & Rectem, 1983; De Haan, et al., 1987; Sergent & Poncet, 1990).

Results such as these have led researchers to infer that prosopagnosic patients, at least the ones who manifest covert recognition, do not suffer from an impairment in face recognition per se. The fact that faces can prime semantic classifications in these patients suggests that faces are processed adequately through semantic levels of representation. The fact that faces are associated more efficiently with their correct names in memory suggests that faces are

processed adequately through levels of representations specifying individual identity. In the words of Young and De Haan (1988), "it is reasonable to think of [the prosopagnosic patient's] impairment as involving loss of awareness of the products of the face recognition system, rather than as a breakdown in the face recognition system per se."

However, there is an alternative interpretation of covert face recognition in prosopagnosia which ought to be considered. Perhaps the tests of covert recognition are simply more sensitive tests for detecting residual functioning in a damaged face recognition system. If this were the case, then demonstrations of so-called covert recognition would not support the hypothesis of an intact, or roughly intact, recognition system whose products cannot gain access to conscious awareness. Rather, the covert recognition phenomena would tell us that even in prosopagnosia, when face recognition seems obliterated when measured by conventional tests, there is some residual face recognition ability. The latter hypothesis is less intruiging than the former, but it is also more parsimonious in that it does not postulate separate systems needed for recognition and awareness of recognition.

In the present article we examine a single covert test, the face-name relearning task, with the goal of distinguishing the two hypotheses just stated: That covert recognition reflects the operation of an intact face recognition system deprived of access to consciousness, and that covert recognition reflects a more sensitive measurement of the residual functioning of an impaired recognition system. In the face-name relearning task, the subject is taught to associate the names of well-known people with the faces of well-known people. As stated earlier, some prosopagnosics require fewer learning trials to consistently associate names and faces when they are correctly paired than when they are incorrectly paired. This appears to imply that, at some level, they must "recognize" which names go with which faces.

We have chosen to study the face-name association task because it is the most widely used covert face recognition task in the literature: Six different patients have been tested using this task (Mr. W., described by Bruyer, et al., 1983; P.H., described by De Haan, et al., 1987; M.S., described by Newcombe, Young & De Haan, 1989; B.M.,

described by Sergent & Villemure, 1989; P.V., described by Sergent & Poncet, 1990; and L.H., described by Etcoff, Freeman & Cave, 1991). In addition, variations on the basic task, such as object picture - name pairings, or first versus last name - face pairings, have also been used to explore the limits of covert recognition (Newcombe et al., 1989; Young & De Haan, 1988).

If savings in relearning correct face-name pairings merely reflects the greater sensitivity of this measure to residual visual recognition ability, compared to the sensitivity of overt tests such as naming the faces, then we should expect to observe this same savings in relearning with subjects in whom we know visual recognition ability is degraded. Recognition ability can be degraded either by physical damage to the neural substrates of face recognition, or by the interference and decay processes that underlie normal forgetting in a physically intact system. In the present study, we used simple forgetting, over a six-month interval, as a way of degrading recognition ability. According to the contrasting hypothesis, that savings in relearning reflects the operation of a normal face recognition system, which is able to recognize faces and associate the correct names with them, but which cannot communicate this information to other neural systems necessary for conscious awareness, there is no reason to expect that degrading memories through forgetting will lead to the same results obtained with prosopagnosic patients.

Results

Each subject performed poorly on the two overt recognition tests. Subject 1 recalled the names of 7/40 faces. Chance performance would be 5/40 in this task, because the 8 names for each group of 8 faces were read to the subjects before the recall task. This subject recognized 12/40 of the names, with chance performance again being 5/40. Despite the better-than-chance performance of this subject in the recognition task, he showed little consistency in his correct answers; only 2 of the 40 faces were identified correctly on both overt tests. Subject 2 recalled the names of 10/40 faces, and recognized 12/40. Her consistency was also low; only 4 of the 40 faces were identified correctly on both overt tests. It should be noted that when patients

are tested for overt recognition, they are usually asked to name the pictures without being given a fixed set of possible names, and it is therefore impossible to determine whether their overt recognition performance is literally at chance levels, or whether, as with our subjects, it is merely very poor but above chance. Perhaps for this reason, deHaan et al., 1987, have carried out their relearning experiments only with faces that their subject failed to identify overtly. One of the analyses to be presented below corresponds to this method.

In contrast to the poor performance on overt tests, these subjects showed a clear and consistent tendency to learn the original face-name pairings more effectively than the new pairings. Subject 1 made 26/200 errors with the original pairings, and 57/200 errors with the new pairings. This difference was significant by Yates-corrected chi-squared test, p<.001.[1] Subject 2 made 28/200 errors with the original pairings, and 60/200 errors with the new pairings. This difference was also significant, p<.001. There was no reliable difference between faces learned to different criteria. Subject 1 made 40/100 errors for pairings in the once-correct criterion group, and 43/100 errors for pairings in the twice-correct criterion group. Subject 2 made 38/100 errors for pairings in the once-correct criterion group, and 40/100 errors for pairings in the twice-correct criterion group.

In order to provide a stronger test of the dissociation between overt and covert measures observed in this experiment, we eliminated the data from faces that subjects had successfully identified in either of the two overt tests. This simulates the procedure of deHaan et al., 1987, in which only faces that the patient failed to recognize overtly were included in the savings in relearning task, although it is even

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[1]Although cognitive psychologists usually test for reliability over subjects, we are testing the reliability of this difference over items within a subject. With a single subject design, it is of course impossible to test the generality of the results over different subjects in the population. However, this is not the goal of the present study. Our goal is simply to find out whether, when face recognition is degraded for reasons other than brain damage leading to prosopagnosia, we can observe savings in relearning for previously learned face-name associations. That our results have some degree of generality, and are not confined to a single remarkable case, is demonstrated by the similarity in the performance of both of our two subjects.

more conservative in that our subjects had two opportunities to overtly recognize each face. This did not affect the pattern of results obtained. Counting only the data from faces that were named incorrectly in <u>both</u> overt tasks, subject 1 made 17/55 errors with the old pairings and 31/60 errors with the new pairings, and subject 2 made 18/45 errors with the old pairings and 40/65 errors with the new pairings. These differences were significant in both cases, $p < .05$.

Discussion

The fact that simple forgetting of face-name associations in normal subjects leads to a dissociation between overt recognition performance and savings in relearning has implications for the interpretation of this dissociation in prosopagnosic patients. In prosopagnosic patients, this dissociation has been taken as evidence that recognition per se is <u>not</u> impaired, but rather the access of recognition systems to other systems underlying conscious awareness is limited. The present results challenge this inference, by showing that degrading the representations underlying recognition per se can lead to the aforementioned dissociation. Even when we excluded faces that had been overtly recognized, as had been done with prosopagnosic patients, we found that normal subjects were more efficient at learning the forgotten face-name pairings than the new ones. Of course, this argument could have been made in the abstract by pointing to the extensive literature on savings in relearning in cognitive psychology (e.g., Nelson, 1978). Our goal here was to apply the argument more directly to the issue of covert recognition in prosopagnosia, by using procedures and stimuli similar to those in the prosopagnosia literature.

The locus of memory degradation in our subjects may or may not be visual memories of faces per se. In this respect, the process of normal forgetting in this task may be a poor model for prosopagnosia. However, our objective was not to simulate prosopagnosia, but rather to learn something about the most commonly used <u>task</u> for studying covert recognition in prosopagnosia. We found that savings in relearning can be observed with face-name pairings for which normal subjects no longer show knowledge when tested overtly. This suggests that savings in

relearning is a much more sensitive measure of this knowledge than the overt tests. Thus, the finding of savings in relearning face-name pairings in prosopagnosia does not necessarily imply that such patients have normal or near-normal face recognition ability, and is consistent with the hypothesis that their impairment lies in face recognition per se.

If covert recognition in prosopagnosia reflects the functioning of an extremely impaired, but not obliterated, face recognition system, then why do some prosopagnosic patients demonstrate covert recognition and others not? The answer may be that the patients who do not show covert recognition have more complete damage to their face recognition systems. The lack of quantifiable, standardized tests of overt face recognition makes this prediction difficult to test with the available cases.

Of course, our findings concern only savings in relearning, and not all of the tasks used to demonstrate covert recognition in prosopagnosia. The relearning task was chosen because it is the most widely used of the covert recognition tasks. However, in addition to being widely used, savings in relearning is also correlated with the other measures of covert face recognition that have been used; patients who manifest covert recognition on this task also manifest it on the other tasks, and patients who do not manifest covert recognition on this task do not manifest it on the other tasks. It therefore seems unlikely that the mechanism underlying savings in relearning in prosopagnosic patients will be different from the mechanism underlying other measures of covert recognition. The possibility that small amounts of residual recognition ability could provide the basis for the other measures of covert recognition finds some support in a recent computer model (Farah, O'Reilly & Vecera, 1991).

In closing, we wish to emphasize that our findings do not imply that the phenomenon of covert recognition is trivial or of no theoretical interest. What we have questioned here is whether awareness of recognition can be obliterated in the context of perfectly intact recognition, and therefore whether awareness of perception relies on neural substrates that are distinct from perception itself. The fact that an impaired recognition system might be capable of some degree of

recognition when assessed with "covert" tasks, but have no ability to perform "overt" tasks involving conscious awareness, is surely relevant to the relation between perception and awareness. It suggests that a certain degree or quality of visual information may be a necessary condition for visual awareness. Whether this is indeed true, and what the critical aspects of "information quality" might be, must be left for future research.

Methods

Materials

Black and white 3"x5" photographs of 40 different caucasian male graduate students were used in this study. These students were in their 20's, had average haircuts, no facial hair, and were photographed without glasses and with a neutral expression on their face. None were familiar to the subjects in this study. Photographs were cropped at the shoulders and had a neutral background. Two identical photographs of each face were used so that the subject could not use cues such as smudges to identify a particular face. All photographs were laminated. Each photograph had a sticker on the back which contained a number identifying the face. Forty common male names were selected.

Procedure

All teaching and testing sessions were done individually with each subject. The procedure can be divided into three main phases. First, subjects were taught to associate names with the forty faces. This corresponds to the premorbid learning of faces by prosopagnosics. The experimenter said the name as she held up each photograph. The subject was allowed to see each face for two seconds after hearing the name and then the experimenter removed the photograph from view and presented the next one. The subject was exposed to twenty of the name-face pairs and tested to criterion before being exposed to the other twenty. Subjects learned twenty of the faces to a criterion of naming the face correctly once and the other twenty to a criterion of naming each face correctly twice. Two different criteria were used in order to achieve a range of familiarity with the faces, and thus increase the probability of

attaining nonceiling and nonfloor performance on the subsequent phases of the experiment.

The criterion testing consisted of the experimenter holding up the photograph and the subject producing a name. In the once-correct criterion, if the name produced was correct the experimenter set the photograph aside and it was not retested. When the subject named a face incorrectly the experimenter said the correct name and put the photograph in a pile to be tested again. After finishing the current photographs the experimenter would shuffle the pile of photographs to be retested and repeat the procedure until the subject had correctly named each face. The procedure was the same for the twice-correct criterion except the whole criterion testing procedure was repeated after the subject had named each face correctly the first time.

The second and third phases of the procedure correspond to the relearning task itself. In the second phase, subjects returned approximately 6 months after the initial session to be tested for overt recognition, and to be re-taught the face - name pairings.[2] The 40 faces were broken into five groups of eight and tested on two separate days. Each group of eight contained four faces learned to the once-correct correct criterion and four learned to the twice-correct criterion.

Each subject was given two overt tests. In the recall test, the subject was told the eight names of the faces to be tested. Subjects were not allowed to write down the names, but were told that the entire list of eight would be repeated any time they asked. This was to prevent subjects from keeping track of which names they had already used. The experimenter held up one picture at a time and asked the subject to identify the face. The subject was required to respond to each face and was instructed to guess if necessary.

The subject was then given the second overt test, the recognition test. All eight faces were set in front of the subject in a 2x4 grid and the experimenter asked the subject to point to the face

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[2]Earlier pretesting with a smaller set of faces had shown that a four to six week delay was not sufficient for subjects to perform near chance on the overt tests used. Even at the six month delay, a third subject performed well on the overt tests of recognition, and was therefore not tested further.

corresponding with each of the eight names, which the experimenter gave in a random order. The photographs were shuffled and replaced between the fourth and fifth names in order to prevent the subject from using a spatial strategy to remember which faces had already been used.

Following the recognition test the subjects were told that they would be retaught the face-name pairings. They were informed that some of the pairings would be the same and some would be different, but that the same forty names and faces would be used. This reteaching was done in the same five groups of eight as the overt testing had been done. Half of the pairings were the same ones the subject had initially learned. Half of the pairings were different. New pairings were made within the same criterion group. Each group of eight faces now contained two once-correct criterion faces with the same names learned originally, and two with the names switched. It also contained two twice-correct criterion faces with the same names learned originally, and two with the names switched.

During the retraining, each face was presented once. The experimenter read the name, allowed the subject to view the photograph for two seconds and then removed the photograph and presented the next. Because pilot subjects were at ceiling on tests given immediately following retraining, the third phase of the procedure was carried out between one and ten days following the retraining.[3]

Efficiency of relearning was tested as follows: The photographs were tested in the same sets of eight used for the reteaching. The eight photographs from the group were displayed in a 2x4 grid and the subject was asked to to point to the face corresponding with a name given by the experimenter. After every 4 names the photographs were shuffled and replaced with the alternative set. Each name was tested 5 times. Feedback was given only after the fourth and fifth trial. Feedback was not given on every trial, as it had been with the prosopagnosic subjects in the literature, because our subjects showed one trial learning.

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[3]Subsequent analyses showed no effects of delay on the relevant pattern of performance.

Subjects

Two psychology graduate students, who were not familiar with the literature on prosopagnosia, volunteered to participate. Subject 1 was a 35 y.o. male. Subject 2 was a 23 y.o. female. Neither subject had any history of neurological dysfunction, or difficulty recognizing faces.

Acknowledgements

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